The Veliger 27(3):308–311 (January 2, 1985)

THE VELIGER

A Comparison of Two Florida Populations of the Coquina Clam, *Donax variabilis* Say, 1822 (Bivalvia: Donacidae). II. Growth Rates

by

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Abstract. Average summer growth rates of 3.0 mm and 3.7 mm per month were obtained for samples of *Donax variabilis* from southwest Florida and central eastern Florida, respectively, using length-frequency graphs. Individuals usually live only one year.

INTRODUCTION

Previous studies on the growth of *Donax variabilis,* the coquina clam, were done in Texas (Loesch, 1957) and North Carolina (Pearse *et al.,* 1942). However, these studies were conducted prior to the designation of a new species, *Donax dorotheae* Morrison, 1971, which occurs from northwest Florida to northeast Texas. In addition, many of the "young" of *D. variabilis* from the eastern United States now in the collections of the Smithsonian Institution and the Academy of Natural Sciences were determined to be *Donax parvula* Philippi, 1849 (see Morrison, 1971), indicating identification problems in the past. Morrison (1971) also split *D. variabilis* (as *D. roemeri* Philippi, 1849) into western (western Gulf of Mexico) and eastern (eastern Gulf of Mexico and eastern United States) subspecific forms. Marsh (1962) examined length-frequency graphs of *D. variabilis* collected during the summer and early fall from Pawleys Island, South Carolina, but found no well-defined size classes. Therefore, the growth rates of the eastern and western forms of *D. variabilis* possibly remain undetermined. In this paper, summer growth rates of *Donax variabilis* are given from two Florida populations, along with estimates of spawning periods and lifespan.

MATERIALS AND METHODS

Specimens of *Donax variabilis* were collected monthly (primarily for analysis of coloration and population density) from April through September 1976. Specimens were gathered from eight transects perpendicular to the beach, each consisting of about eight 15-cm diameter cores spaced at 1-m intervals within the intertidal zone of exposed sandy beaches on the central eastern (Indialantic) and southwestern (Sanibel Island) coasts of Florida. Samples were sieved using a 1.2-mm mesh. The number of monthly cores varied due to the varying width of the swash zone being sampled at the time; the number of monthly cores averaged 40 at Sanibel and 49 at Indialantic Beach. Half of the transects were at 25-m intervals and half at 5-m intervals to decrease the possibility of missing localized aggregations of animals. *Donax parvula* was collected along with *D. variabilis* at the Indialantic site, but specimens of the former were separated and not analyzed for this study. Other information concerning sampling locations, methods, and times have been given previously (Mikkelsen, 1981). Shell lengths were measured with calipers to ±0.1 mm. The large samples of shells from Sanibel (excluding the April sample) were subsampled using a geological sediment sample splitter; all specimens from Indialantic were measured. Groupings to determine "sets" of individuals on length-frequency graphs were determined according to Cassie (1954).

RESULTS

At Indialantic Beach, 477 specimens of *Donax variabilis* were collected and analyzed. One portion of the year class had somewhat regular monthly growth increments from May through August (crosshatched area, Figure 1). The mean shell length of these individuals increased from 7 mm in May to 18 mm in August, an increase of 11 mm over a period of 3 months, or an average summer growth rate of about 7.3 mm per month. Another set of young occurred, averaging 9 mm in length in the third week of September (stippled area, Figure 1).

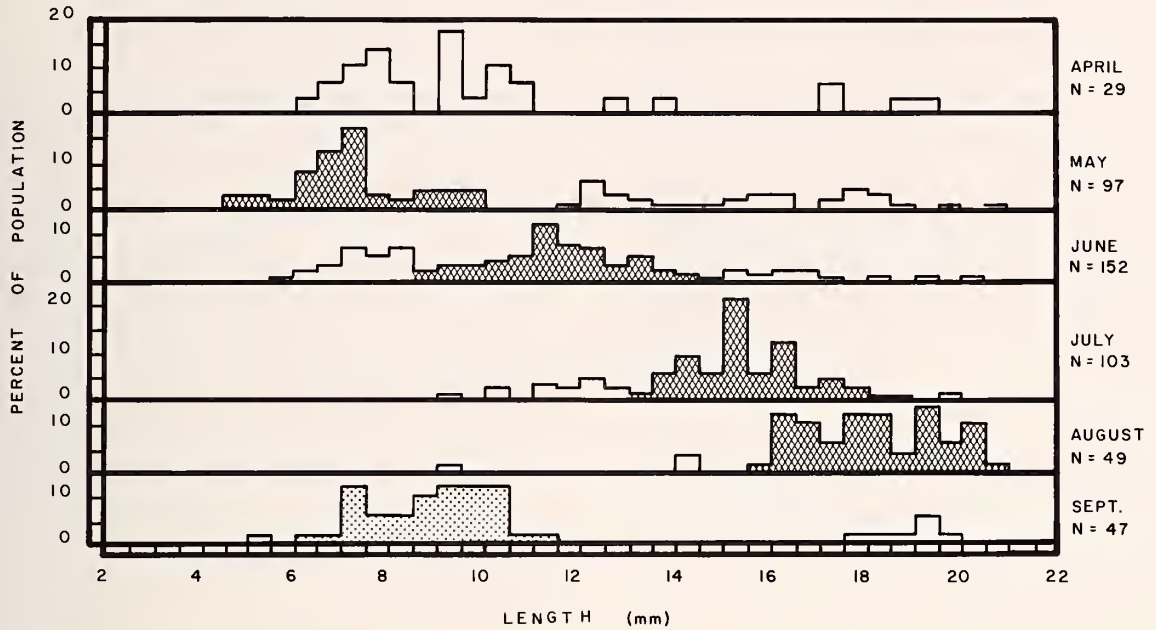

Figure 1

Length-frequency graphs of *Donax variabilis* from Indialantic (N = number of specimens). First set (crosshatched); second set (stippled).

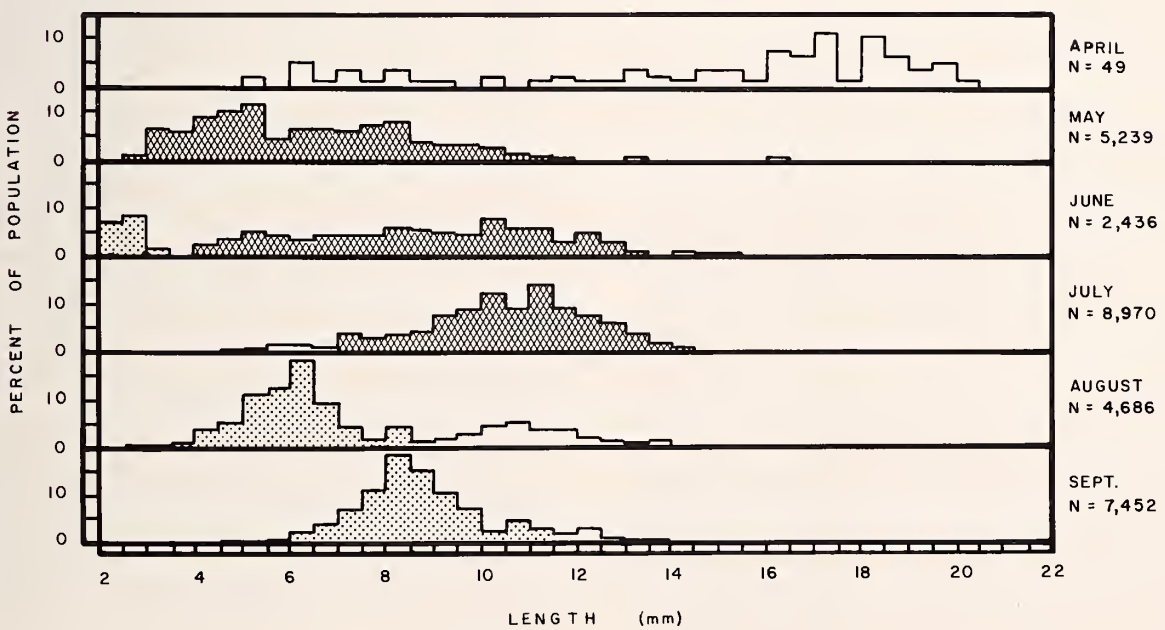

Figure 2

Length-frequency graphs of *Donax variabilis* from Sanibel (N = number of specimens). First set (crosshatched); second set (stippled).

At Sanibel, because 28,832 specimens were collected, subsamples provided manageable numbers, yielding monthly subsamples consisting of about 500 specimens each. The size classes could be followed from May through July (crosshatched area, Figure 2). The means of the distributions pass from 5 to 11 mm over a period of 2 months (May to July) and from 6 to 9 mm over 1 month (August to September), indicating an average summer growth rate of 3.0 mm per month. The Sanibel Island population also showed a second set of young (stippled area, Figure 2) around the first week of June; these had subsequently grown to a mean size of 6 mm by August and to 9 mm in September.

DISCUSSION

Constant movement of beach sands and contained clams, as well as the migratory ability of *Donax variabilis,* prevented use of a "mark-and-recapture" technique of growth measurement. Thus, repeated sampling of the population to construct length-frequency graphs was used, although problems exist with its use.

Loesch (1957) in a study of two species of *Donax* pointed out that length-frequency curves can indicate growth only if (1) the mortality rate is the same for all sizes of individuals, (2) the clams enter the population as an entire group, and (3) there is no drift of specimens along the beach. In addition, permanent or temporary removal of individuals by wave action may wash specimens into the subtidal region (Mikkelsen, 1981). Also, predators may selectively remove a particular size of clam. Many of the predators listed by Loesch (1957) were confirmed during the present study, and to that list is added the Sheepshead fish, *Archosargus probatocephalus* (Walbaum, 1792); Leber (1982a, b) added others. Selective removal by each of these predators seems likely and probably varied monthly depending upon the type, abundance, and size of the predators. This selectivity could have contributed to the skewing of the length-frequency data (Figures 1, 2), seemingly altering regular monthly growth increments present in individuals. Thus, growth alone may not be the reason for the position and rate of advancement of the modes and means present in the length-frequency graphs.

An additional factor is that the monitored population must consist of a single species. Approximately 54% of the *Donax* collected at Indialantic Beach were *D. parvula* and were not analyzed for this study. In his analysis of growth rate of *D. variabilis* from the Texas coast, Loesch (1957) may have inadvertently included specimens of *D. dorotheae* and/or *D. texasiana,* similar but shorter and more obese species, whose ranges overlap that of *D. variabilis* in the western Gulf of Mexico. This factor could have influenced Loesch's lower growth rates of 1.75, 0.67 and 0.33 mm per month in his populations from three separate stations. However, this extreme variation may be real, and growth rates determined in the present study may be high because they are merely summer growth rates, rather than an average over the year. Sanibel Island presented no identification difficulties because *D. variabilis* was the only donacid that occurred there.

Assuming a constant growth rate, the occurrence of numerous individuals in the May sample at Indialantic Beach whose lengths were clustered around 7 mm indicates a settlement approximately 7.5 weeks prior to that time, or about the first to second week of March. Thus, with a larval stage of 3 weeks average duration (Chanley, 1969), spawning may have been centered around the third week in February. The second group of young at Indialantic (averaging 9 mm in the third week of September) indicates a second spawning occurred on the east coast about 13 weeks earlier, or about the second week of June.

Following the same assumptions at Sanibel, settlement may have occurred, at 275 to 340 μm (Chanley, 1969), around the second week of March, with spawning centered around the third week of February. This is essentially identical to the first spawning that occurred at Indialantic Beach. The second group of young at Sanibel indicated that a second spawning probably occurred about the second week of May and settlement about the first week of June. This second spawning at Sanibel was about 4 weeks earlier than the second spawning and settlement at Indialantic Beach.

Although spawning dates were extrapolated from length-frequency graphs, they may be reasonable estimates. Causes of error would include a more rapid growth rate for individuals younger than those examined. Correction for this error would yield spawning dates somewhat later in time. The dates reported herein differ, however, from those given for the North Carolina populations that were reported to have planktonic larvae from summer to fall (Williams & Porter, 1971). Leber (1982a) observed settlement of *Donax variabilis* in North Carolina during February and November.

The general absence of an abundance of large *Donax variabilis* throughout the summer months indicates that most of those specimens that had matured the previous fall and winter had probably died, although some may have moved and remained offshore. This suggests that the majority of individuals probably live for approximately 1 year, with a few entering a second year. This is consistent with the findings of Loesch (1957) and Pearse *et al.* (1942) who also used length-frequency graphs. Marsh (1962) also noted fall declines in the intertidal density of *D. variabilis.* Although Leber (1982a, b) attributed fall declines in the number of *Donax variabilis* to emigration to subtidal levels, Leber (1982a, fig. 3) also noted only a few large specimens entering a second year (at least intertidally). However, Morrison (1971), who compiled data by measuring museum specimens, determined a 2-yr life span.

ACKNOWLEDGMENTS

I thank Drs. Robert H. Gore, Robert W. Virnstein, and Kerry B. Clark for reviewing early drafts of the manu-

script. My gratitude is also due to Sally Hatton, Edward Kobovitz, Alan Siegel, and Debbie Wells who helped with the sampling, and especially to Paula Mikkelsen whose assistance with all aspects of the study is most appreciated. Contribution number 367 of the Harbor Branch Foundation, Inc.

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